

MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XLVIII.

APRIL 13, 1888.

No. 6

W. H. M. CHRISTIE, M.A., F.R.S., President, in the Chair.

John Edmund Drower, May Trees, Endlesham Road,
Balham, S.W.;

George James Newbegin, Esq., Thorpe St. Andrew, Norwich;
and

Captain George William Read, F.R.G.S., 1 Broad Street,
Penrhyn, Cornwall,

were balloted for and duly elected Fellows of the Society.

On the Occultations of Döllén's list of Stars, observed at the Royal Observatory, Cape of Good Hope, during the Total Eclipse of the Moon, 1888, January 28. By David Gill, LL.D., F.R.S., Her Majesty's Astronomer at the Cape.

In accordance with Dr. Döllén's request, preparations were made for observing, during the total eclipse of the Moon on January 28, the occultations of stars whose times of disappearance and reappearance had been computed by him for this observatory.

It is to be regretted that his letter containing the request in question only reached the Cape about a week before the eclipse, otherwise it might have been possible to comply with his further request—viz. to establish another temporary observatory twenty or thirty miles distant, so that the same occultations might be observed at slightly different parts of the limb, and thus the effect of accidental irregularities of the limb on the resulting parallax and diameter might be, to some extent, eliminated.

Under existing circumstances, however, all that could be done was to forward without delay to Mr. Nevill, Director of the Natal Observatory (better known to astronomers as Mr. Neison), a copy of the list of stars with an explanation of Dr. Döllén's request, and Mr. Nevill was fortunately able to make such good use of his time as to compute the necessary predictions,

and to secure observations of ten disappearances and seven reappearances, the particulars of which he will doubtless communicate to the Society.

The observers and instruments at the Cape, together with the coordinates of their points of observation relative to the transit-circle, are given in the following Table I.

The error of the normal transit clock was determined by observations of four time stars by Mr. Finlay and two pole and two time stars by Mr. Maclear. The means of their determinations have been adopted. The observations for time were made by the eye and ear method, the beats of the clock being rendered audible by a "sounder" in the chronograph circuit.

The times of disappearance and reappearance were recorded at the heliometer and the 7-inch and 6-inch equatorials on local chronographs placed in these observatories in circuit with the transit clock. The observations with the 5-inch guiding telescope of the stellar photographic apparatus were made by "eye and ear," with a chronometer which was compared with the normal transit clock (using the beats of the sounder) before and after the observations.

The times of the phenomena as recorded by the various observers are given in the following list, together with the notes of the observers.

The eclipse of 1888 was remarkable for the brilliancy of the eclipsed disc of the Moon as compared with that of 1884. This brilliancy rendered it impossible, at least with the comparatively small instruments at disposal, to observe the disappearance or reappearance of the faintest stars on the list. With the 5-inch telescope it is certain that in several instances the light of the neighbouring limb of the Moon produced apparent occultation too soon and apparent reappearance too late, and no certain distinction between true and apparent phenomena appears to have been drawn by the observer. These doubtful cases are marked (?), and should not be employed in the discussion of results.

Had it fortunately happened that similar conditions as to the brilliancy of the eclipsed Moon had occurred in 1888 as in 1884, it is probable that the whole of the predicted occultations might have been observed. The sky was beautifully clear throughout totality.

TABLE I.

Observer.	Instrument.	Aperture	Position relative to	
		in inches. Inches.	transit-circle in feet. Feet.	Feet.
Gill	Heliometer (one segment of the object-glass only used)	7 $\frac{1}{4}$	N. 200	E. 58
Finlay	Merz Equatorial	7	N. 197	W. 145
Maclear	Guiding telescope of the star photographic apparatus	5	S. 365	E. 52
Cox	Grubb Equatorial	6	S. 393	E. 75

TABLE II.
Local Sidereal Times.

Star's Number on Döllén's List.	Phenome- non Observed.	Observed by D. Gill.	Observed by W. H. Finlay.	Observed by G. Maclear.	Observed by W. H. Cox.
		h m s	h m s	h m s	h m s
127	D.	...	8 14 36.8	8 14 35.6	
121	D.	...	(c) 16 1.2	15 55.6?	
76	R.	...	24 40.9	...	
146	D.	8 28 28.2	28 26.4	28 26.7	
143	D.	29 5.3	(d) 29 4.8	...	
147	D.	...	...	31 41.2?	
122?	R.	(a) 31 40.8	...	...	
88	R.	...	31 44.4	...	
95	R.	(b) 44 20.0	...	44 53.4?	
158	D.	...	56 30.3	...	
159	D.	58 45.3	(e) 58 45.4	58 45.6	
111	R.	...	9 0 50.9	...	
107?	{ R.	...	...	9 0 59.0?	
	{ R.	...	...	1 25.1?	
121	R.	...	9 2 54.9	3 9.4?	
113	R.	...	5 57.8	6 29.4?	
127	R.	9 21 10.7	...	21 14.3?	
173	D.	...	23 29.8	...	
132	R.	...	...	(k) 27 46.4?	
191	D.	28 6.8	...	...	(m) 9 28 6.7
189	D.	43 17.0	(f) 43 15.9	43 9.9?	
179	D.	50 39.1	(g) 50 39.1	(l) 50 38.9	
146	R.	...	(h) 53 59.9	...	

Notes.

(a) Position-angle 189°.

(b) Doubtful. [Note.—This star was noted by Mr. Finlay as “some way from the limb” at 8^h 44^m 29^s, and even at 44^m 20^s it was not *certain* that the first instant of reappearance had been observed.—D. G.]

(c), (d) Uncertain.

(e), (g), (h) Good.

(f) Very good. Star seen within Moon's limb.

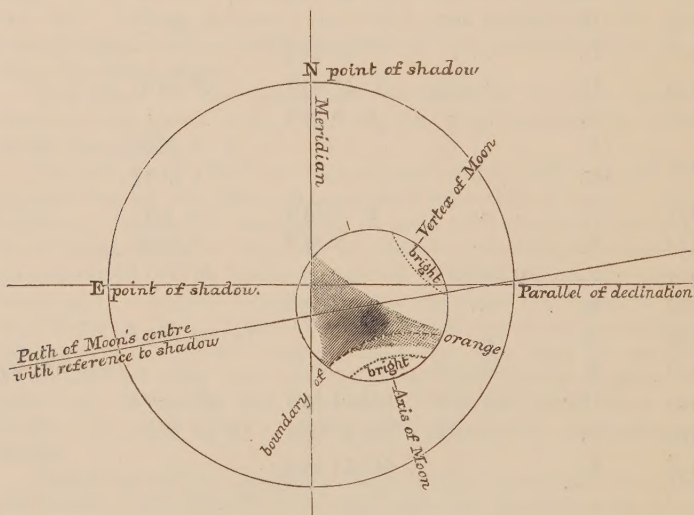
(k) Perhaps a little late. Very faint. (l) Very good. (m) Very good.

The Total Eclipse of the Moon, 1888, January 28.

By T. W. Backhouse.

(Abstract.)

The general appearance was very much the same as in the total eclipse of 1866, March 30—perhaps a more brilliant orange, the greater part of the shadow being of that colour, while the border was yellow, and the extreme edge white, if not bluish. The total light of the Moon was least about the middle of the eclipse, at which time, as seen out of focus through an opera-glass reversed, and by indirect vision, it appeared to be two-thirds as bright as *Saturn*, and about two and a half times as bright as *Pollux*. At 10.50 it was twice as bright as *Saturn*.



At 10.52 the lower half of the Moon, with the exception of those portions towards the right-hand and the left-hand parts of the lower limb, seemed abnormally dark, the darkest part being a little south of the centre. I send a drawing of this abnormal darkness, as well as I could ascertain it apart from the lunar features, showing its position in the Earth's shadow. It was difficult to separate the abnormal darkness from the lunar features, and it is quite likely that the extreme darkness of the portion near the middle was partly due to Mare Nubium, though unfortunately I did not record its exact position relative thereto. The brightness of the lower left-hand limb was probably due to the lunar features and not to any difference in the intensity of

the Earth's shadow at that part. The actually brightest portions of the Moon were those two marked with the dotted lines, viz. the lower right-hand portion, and the upper portion between Mare Tranquillitatis and the limb. As the region between these two parts was that nearest the edge of the Earth's shadow, I conclude that the abnormal darkness really extended right across the Moon, mainly in a broad irregular belt from position-angle 250° to 130° .

There was also a difference in colour between the northern and southern parts of the right limb not to be accounted for by the distance from the edge of the shadow, there being no tinge of orange but only yellow in the south preceding part marked off by the broken line, while all the rest of the disc was orange.

I noted the occultation of a bright star at $10^{\text{h}} 38^{\text{m}} 51^{\text{s}}$ (with a possible error of about 1 second or perhaps 2 seconds); it disappeared instantaneously at position-angle about 110° .

Sunderland: 1888, February 27.

The Total Eclipse of the Moon, 1888, January 28.

By W. F. Denning.

(Abstract.)

This phenomenon was observed at Bristol under the best possible conditions of weather. The sky was cloudless the whole time.

As soon as the umbra had well entered upon the Moon's limb I observed that it was not nearly so dark as in the eclipse of 1884, October 4. On that occasion during the partial phase I could not discern the outline of the Moon at all in my 10-inch reflector until near the period of totality, when it became feebly perceptible. But in the present instance the immersed limb was very obvious, and it could be distinguished with the naked eye, especially after 10^{h} , the appearance being very similar to what is observed near the time of new moon, when our satellite is faintly visible in full outline by the effects of earthshine.

The total phase was reached at $10^{\text{h}} 31^{\text{m}}$, and now the Moon's disc displayed a vivid extent of colouring. The entire surface remained distinctly perceptible to the naked eye, the brightest coppery hues being upon the upper limb where the outer limits of the shadow fell. The interior parts were suffused in a red glow of varying depth. At the middle of totality the darkest tints were near the Moon's centre, while the marginal zone was quite bright by contrast, and enabled the globe of our satellite to be sharply defined upon the background of dark sky. On October 4, 1884, the central part was much the brightest at the middle of the eclipse, while the extreme faintness of the outer

region had the effect of greatly reducing the Moon's diameter, so that to the naked eye it looked like a planet struggling through dense haze or a nebula with ill-defined outline.* The appearance of the Moon on the two occasions was therefore utterly dissimilar, and proves that some remarkable change had occurred in the condition of our atmosphere as the medium of refracting a portion of the solar rays to the Moon when in eclipse.

When we consider that the great ring of air concerned in this refraction includes every climate existing between the poles, and that it varies rapidly in longitude owing to the Earth's rotation, it will be seen that any local or partial effects must be annihilated, and that, if our atmosphere is really the chief agent in producing dark and light eclipses, its *general* humidity must undergo surprising changes.

Bristol: February 1888.

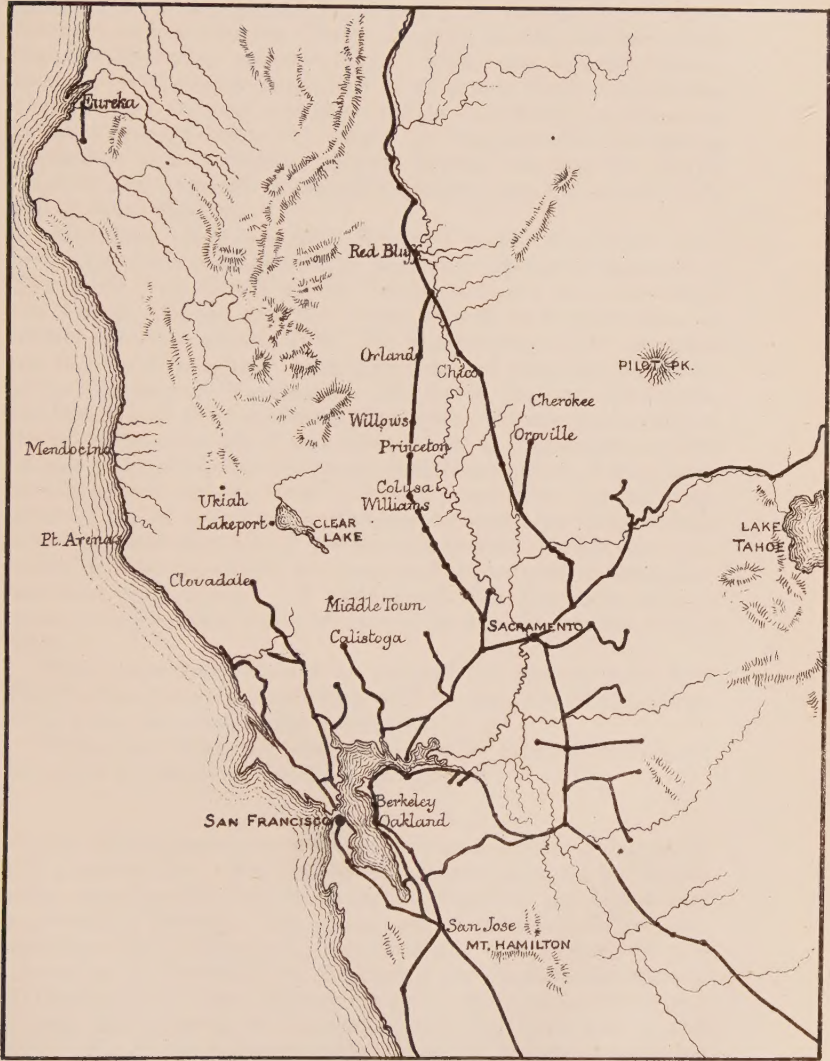
The Total Solar Eclipse of 1889, January 1, in California. Probable Meteorological Conditions at that Time. By Edward S. Holden, LL.D., Foreign Associate, R.A.S.

(Extract from a letter to Mr. Knobel.)

In order to assist intending observers of this eclipse to form their programmes of observation, I have requested the authorities of the U.S. Signal Service at Washington and at San Francisco to furnish extracts from their records of cloudiness at various Californian stations near the line of total eclipse for the last fifteen days of December and the first fifteen days of January. This request has been courteously complied with, and the data available are printed in the tables which follow, as well as some others which I owe to the kindness of Major Heuer, U.S. Corps of Engineers, Inspector of Lighthouses in California. In order to draw conclusions from these tables, it is necessary to say a few words on the climate of California as affected by topographic conditions.

During the greater part of the year the ocean near the coast is covered by fogs. The coast towns, as Mendocino, Eureka, Punta Arenas, &c., thus have a high percentage of cloudiness. The coast range of mountains on its western (seaward) slope is a region of comparatively great rainfall, therefore the eastern slope of these mountains is likewise considerably affected. The interior valleys, as the valley of Clear Lake (Lake County) and the great Sacramento Valley, being protected from the prevailing western winds, are far more sunny, and this is true during the whole year. January is a particularly unfortunate time of year for astronomical work, since it falls in the middle of the wet season, when it is possible that rainy periods of a week or more may be experienced all over northern California.

* *Monthly Notices*, vol. xlv. p. 43.



Spottiswoode & Co. Lith. London.

Railway Map of Northern California.



Digitized by the Internet Archive
in 2026

At the close of the rainy season (about April), unbroken clear weather may be expected for a period of six months or more, as may be seen by referring to the meteorological records in vol. i. of the *Publications of the Lick Observatory*.

Transportation.

Railways lead from San Francisco to Cloverdale (Sonoma County), to Calistoga (Napa County), to Colusa, &c. (Colusa County), to Oroville, &c. (Butte County), as may be seen from the accompanying railway map. From the various railway stations good waggon roads lead to all points likely to be chosen for observing stations, and there will be no difficulty in procuring suitable transportation by stages or waggons, nor in finding mechanics and labourers. Punta Arenas can also be readily reached, and tolerably comfortable quarters can be secured there and at other stations.

Intending observers from England or the Continent may best bring their instruments as personal luggage by steamer to New York. At New York the boxes will have to be opened at the Custom House, and the boxes should be so fastened as to readily allow the examination. The instruments will be admitted free of duty if a special permit be obtained from the Secretary of the Treasury at Washington. No doubt Professor Newcomb, the Director of the American Ephemeris at Washington, or any of the astronomers at the Naval Observatory at Washington, would be glad to expedite free entry of such instruments, if they were communicated with by letter a month or so before leaving England. I am, of course, not authorised to speak for them, except in this general way, but I have no doubt that suitable arrangements will be promoted by them, and announced to intending observers in due time. I understand that Congress will be asked to appropriate a sum of money for the observation of this eclipse.

The instruments should be shipped *by express* from New York to San Francisco, and they will be found at Wells, Fargo & Co.'s express office in the latter city.

From San Francisco the boxes can be *expressed* to almost any point in California by the same company.

Observing Parties.

The Lick Observatory will send at least one observing party to the central line. The eclipse will also be observed by parties under the direction of Professor Davidson, of the U.S. Coast and Geodetic Survey. The permanent observatory of Professor Davidson (San Francisco), the Students' Observatory of the University of California (at Berkeley), the Chabot Observatory (at Oakland), the Lick Observatory (near San José), and various private observatories in California, will also take part in the work. No doubt a considerable number of eclipse expeditions will be formed in the Eastern States and sent to California.

Time Signals.

Time signals sent from the Lick Observatory are received daily (at Pacific standard noon) at nearly every railway station in California. On the days immediately preceding and following the eclipse, they will be automatically transmitted from our standard clock, and special pains will be taken to make them useful to observing parties in the field.

The Positions of the Observing Stations

will, in general, have to be determined by observation, as no accurate topographical survey has been made for the interior of California. Points near the coast will have been accurately determined by the U.S. Coast and Geodetic Survey parties. Stations in the interior can usually be connected with the permanent marks of the (rectangular) surveys of the U.S. Land Office.

The Lick Observatory.

I hope that none of our foreign visitors will leave California without paying a visit to the Lick Observatory, where our corps of astronomers will be pleased to receive them. As our accommodations for guests to the mountain are quite limited, it is necessary that an appointment for the visit should be made several days in advance, and I would ask correspondence in regard to this. I regret that the opportunity for such visits falls in our most unfavourable season, but I shall hope for weather clear enough to enable some idea to be formed of our instruments and equipment. At any rate, I am sure that I can promise to all our foreign guests a magnificent mountain view, and a hearty welcome.

Meteorological Data.

The tables follow in the form in which I have received them. With a map of the region and with the explanations I have given, each intending observer can use his own judgment in the selection of a station. I have preferred not to express any definite opinion on a subject so uncertain as California weather in January, but to present the data simply.

General Average Cloudiness for Each Day at Four California Stations, from the Records of the U.S. Signal Service.

		DECEMBER.												JANUARY.																			
Stations.	Year.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Eureka, Cal. ...	1886-7																	00	57	47	60	100	47	00	70	60	93	100	67	67	57		
	1887-8																	100	100	47	67	57	37	27	00	00	17	77	67	67	00	30	
Cape Mendocino, Cal.	1885																	Average daily cloudiness, January 1885, 61.7															
	1885-6	33	83	13	17	83	80	100	100	100	100	47	40	13	37	27	53	00	37	00	17	40	43	10	50	00	17	87	100	90	87	50	
	1886-7	50	67	27	40	40	100	100	33	17	87	50	87	100	67	87	40	Average daily cloudiness, January 1885, 46.7															
Red Bluff, Cal. ...	1885																	00	20	00	27	00	10	00	13	00	70	70	60	67	70	70	
	1885-6	100	67	00	100	100	100	67	100	100	67	37	00	00	100	47	30	00	20	00	27	00	10	00	13	00	70	70	60	67	70	70	
	1886-7	87	60	47	50	40	97	97	83	60	67	100	83	100	100	100	00	27	60	00	57	30	20	00	10	00	43	87	90	100	67	57	
	1887-8	7	7	00	00	00	27	7	17	30	43	47	83	100	97	80	73	100	100	7	67	40	00	23	10	00	00	00	00	30	3	33	
Sacramento, Cal. ...	1885																	Average daily cloudiness, January 1885, 52.3															
	1885-6	63	100	100	100	100	87	67	93	87	67	63	00	13	00	100	23	00	00	00	00	00	00	00	00	00	00	60	33	00	00	53	
	1886-7	80	13	00	17	00	60	67	67	53	80	90	23	100	100	67	00	00	33	00	30	23	00	00	00	00	00	00	00	33	67	67	70
	1887-8	00	00	00	00	00	13	00	00	00	43	60	43	100	100	20	7	100	100	60	30	100	47	00	00	00	00	00	33	37	00	10	

Percentage of Cloudiness at Noon at Four California Stations from Records of the U.S. Signal Service.

		DECEMBER.												JANUARY.																			
Stations.	Year.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Eureka, Cal. ...	1887																	100	50	40	100	100	100	40	00	00	80	100	100	100	70		
	1888																	100	100	40	100	70	50	60	00	00	50	100	100	100	00	90	
Cape Mendocino, Cal.	1885																	Average cloudiness at noon, January 1885, 6.0															
	1885-6	100	70	00	50	80	100	100	100	100	100	30	30	40	00	60		00	80	00	00	70	30	80	00	00	00	100	100	100	80	70	
	1886-7	50	100	50	40	70	100	100	100	100	90	100	60	100	100	90	50	Average cloudiness at noon, January 1885, 5.1															
Red Bluff, Cal. ...	1885																	00	60	00	80	00	00	40	00	00	00	80	100	100	100		
	1885-6	100	100	100	100	100	100	100	100	100	100	100	100	00	00	100	40	10	00	80	00	50	10	30	00	00	30	90	70	100	100	70	
	1886-7	80	80	30	80	80	100	90	80	80	100	100	90	100	100	100	40	20	80	00	80	50	10	00	30	00	00	30	90	70	100	100	70
	1887-8	20	20	00	00	00	60	20	10	70	80	40	100	100	90	90	100	100	100	100	20	20	00	00	00	00	00	00	00	00	00	00	00
Sacramento, Cal. ...	1885																	Average cloudiness at noon, January 1885, 6.0															
	1885-6	90	100	100	100	100	100	100	100	90	70	90	00	40	100	100	70	00	00	00	100	00	00	00	00	00	00	00	100	100	100	00	80
	1886-7	100	00	00	50	00	80	50	10	60	70	100	30	100	100	100	00	00	100	00	90	00	00	00	00	00	00	00	00	100	100	100	100
	1887-8	00	00	00	00	00	40	00	00	00	30	50	90	100	100	30	100	100	100	00	90	100	40	00	00	00	00	00	00	00	80	00	30

Fog Signal Station, Punta Arenas, Cal.

Dec. Year.	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1881	cloudy	clear	clear	clear	cloudy	cloudy	clear	clear	rain	clear	clear	rain	fog	fog	fog	clear	cloudy
1882	fog	fog	...	...	...	...	fog	fog	fog	fog	fog	...	...	...	...	...	...
1883	fog	fog	fog	fog	...	...	...	...	...	...	fog	fog	...	...	...	fog	...
1884	...	...	fog	fog	fog	...	fog	fog	fog	...	...	...	...	...	...	...	...
1885	fog	fog	fog	fog	...	...	...	...	...	...	...	...	...	...	...	...	...
1886	rain	rain	clear	clear	some fog	clear	clear	hazy	fog	hazy	clear	clear	rain	rain	rain	clear	fog
1887	rain	clear	clear	clear	clear	clear	clear	clear	clear	clear	hazy	rain	rain	rain	showers	showers	rain

'Fog' really means that there was use for the fog signal at times during the 24 hours, or for the whole day.

Fog Signal Station, Punta Arenas, Cal.

Jan. Year.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1882	cloudy	rain	cloudy	fog	fog	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear
1883	...	...	...	...	...	...	fog	fog	...	fog	...	...	...	...	...
1884	...	...	fog	fog	...	...	...	...	...	...	...	...	...	...	...
1885	...	...	fog	fog	fog	fog	fog	fog	...	...	...	...	...	...	...
1886	clear	clear	clear	clear	clear	clear	clear	clear	clear	cloudy	cloudy	rain	rain	clear	rain
1887	fog	clear	clear	clear	clear	clear	clear	clear	clear	clear	clear	fog	fog	rain	clear
1888	rain	rain	clear	snow	snow	snow	clear	clear	clear	clear	clear	clear	clear	clear	rain

'Clear' really means that there was no necessity for the fog signal. The sky may have been somewhat overcast.

The following statistics of the total mean monthly rainfall for a few stations near the line of totality may be of some slight moment in determining the relative value of the various places named. No really definite conclusions can be drawn from these, however, for two reasons, *first*, because the rainfall from year to year varies enormously, and *second*, because the rainfall at stations only a little distance from those named in the table may differ largely from the precipitation there set down on account of local topographical reasons.

[From the Report of the State Engineer on Physical Data of California (1886).]

Monthly Means of Rain and Melted Snow.

Stations.	Years.	Annual Rainfall. Inches.	Rainfall, December. Inches.	Rainfall, January. Inches.
<i>Butte County :</i>				
Cherokee	1871-84	43·9	6·08	8·37
Cherokee Reservoir ...	1873-79	60·3	5·77	13·35
Chico	1870-84	20·3	3·55	4·23
Oroville	1880-82	18·9	7·64	4·58
<i>Colusa County :</i>				
Colusa	1871-84	17·2	3·25	3·73
Orland	1882-84	14·7	0·47	1·95
Princeton	1873-84	14·9	2·18	3·24
Williams	1876-84	12·2	1·69	2·83
Willows	1878-84	11·5	2·31	2·09
<i>Lake County :</i>				
Kono Tyee, near Lakeport	1873-84	21·3	2·26	5·13
Middletown	1879-84	41·9	8·67	7·66
<i>Mendocino County :</i>				
Punta Arenas	1875-84	30·5	3·71	6·46
Ukiah	1876-84	32·5	4·69	7·07

Note on Mars. By Richard A. Proctor.

Mars should be carefully observed in June and July for duplication of the "canals" as Martian autumn is approached. Regarding these curious double dark streaks (or rather the bright streaks between them and the fainter streaks on either side of them), as the diffraction-images of Martian rivers at times when mist hangs over the river-beds, as I suggested four years since in the *Newcastle Weekly Chronicle*, we may expect the phenomena to be as noticeable when Martian autumn is approach-

ing as after Martian spring has begun (the reference is to the northern hemisphere, to which the double canals chiefly belong).

I suppose no one regards the double canals as objective realities; but, on the other hand, no one can regard them as optical *illusions*. Regarding them as phenomena of diffraction—that is, as optical *products*—we find an explanation at once of their variable appearance (since when the rivers look dark, as they usually must, on a light ground the duplication would not be observed), of their synchronising with the seasons, and of their being visible only with telescopes between certain limits of aperture. This last consideration suggests an effective method by which this diffraction theory can be put to the test.

It would be well if the appearances seen by Schiaparelli could be seen and delineated by observers possessing the power of delineating them with some degree of artistic skill. No one who has ever seen *Mars* through a good telescope can accept the hard and unnatural configurations depicted by Schiaparelli. The drawings of Dawes, Burton, Knobel, Denning, and Green are far more satisfactory, though some minute details seen by Schiaparelli may not have been within the telescopic range of these careful observers.

It is, I imagine, hopeless to expect that the most powerful of the telescopes constructed within the last quarter of a century will be applied to any work so thoroughly within their power as the examination of the planets' discs for features detected or suspected under the scrutiny of weaker telescopes. It seems to be thought so much more satisfactory to apply these splendid instruments to work which smaller telescopes cannot attempt, that micrometrical observations of the satellites of *Mars*, of *Hyperion*, or of exceedingly minute double stars, must be supposed to add amazingly to our knowledge of the universe, since the large telescopes are so diligently turned on such work, and so carefully kept from entering on work which has already been begun by smaller instruments. Unfortunately all the more important lines of research have been opened with telescopes of comparatively inferior power; so that if the dignity of the larger instruments requires that they shall be used only on lines of work which they and they only can open, we must fear that their work will rather be unique than specially interesting.

Corona Lodge, Orange Lake, Fla.:
1888, March 31.

Observations of Comet a, 1888 (Sawerthal), made at the Royal Observatory, Greenwich.

(Communicated by the Astronomer Royal.)

The observations were made with the East or Sheepshanks Equatorial, aperture 6·7 inches, by taking transits over two cross wires at right angles to each other, and each inclined 45° to the parallel of declination.

Comet a, 1888 (Sawerthal).

Greenwich Mean Solar Time.	Observer.	$\phi - \star$ R.A.	Corr. for Par. and Refraction in R.A.	$\phi - \star$ N.P.D.	Corr. for Par. and Refraction in N.P.D.	No. of Comp.	Apparent R.A.	Apparent N.P.D.	Comp. Star.
d h m s		m s	s				h m s	' "	a b
1888 April 6 16 15 6	H. T.	+0 55·95	-0·30	- 6 14·5	-6·4	6	22 18 27·45	81 0 7·5	a
6 16 19 41	"	-0 38·73	-0·20	+14 35·4	-3·9	4	22 18 29·78	81 0 10·5	b

Mean Places of Comparison Stars.

Star's Name.	R.A., 1888°.	N.P.D., 1888°.	Authority.
h m s			
a Lalande 43672	22 17 32·74	81 6 20·4	Second Armagh Catalogue.
b W. B. XXII. 368	22 19 9·63	80 45 30·9	Glasgow Catalogue.

The observations are corrected for parallax and refraction.

The initials H. T. are those of Mr. Turner.

The comet has been looked for on a number of other mornings, but bad weather has prevented its being seen.

The New Southern Comet. Observations made at Graham's Town, Cape of Good Hope. By L. A. Eddie.

1888, *February 25*.—I obtained this morning a good view of the comet now visible in our south-eastern heavens, situated in the constellation *Telescopium*. It has a very condensed nucleus, equal in magnitude to a 4th magnitude star. The tail could be traced to τ *Telescopii*, 8° from the nucleus, and it possessed some considerable lustre to a point about 3° from the head, where it was fully $30'$ in breadth. A decided curvature could be observed with the concavity towards the south. When viewed through the $9\frac{1}{2}$ -inch Calver it appeared a magnificent object of a deep golden colour, with highly condensed nucleus possessing a nucleolus, or tiny point of brilliant light in the centre. The nucleus was more sharply defined on its posterior border, but no dark interval was traceable. There was but little coma preceding the nucleus, but that around and behind was remarkably brilliant, and was very markedly curved on the southern border immediately surrounding the nucleus. The southern border of the tail was more sharply defined though more rugged in its outline. It was rendered invisible to the naked eye by the daylight at 5 o'clock; the Sun rose at 5.49.

When viewed in the reflector as the day advanced it assumed a variety of interesting forms.

At one time it appeared as a barbed spear, the barbed head resembling two wings; then these faded away and it resembled a ball of fire on the end of a luminous stick; lastly a fluffy ball of pale light alone remained, all vestige of tail and surrounding coma having faded away.

February 28.—The comet was scarcely visible to the naked eye owing to the brightness of the full Moon at $3^h 30^m$ A.M.

It did not appear to have increased in brilliancy. The only change I could detect was a widening of the coma in advance of the nucleus, and a slight trace of dark intervals therein dividing it into cometic envelopes, as in Coggia's Comet of 1874.

March 4.—After a number of cloudy mornings comet again visible in a clear sky. Notwithstanding the brightness of the moonlight it formed a conspicuous object with a tail 3° in length to the unaided vision. On comparing it with the neighbouring objects I concluded that it had slightly increased in brilliancy, and was equal to a star of $3\frac{1}{2}$ mag. When viewed in the reflector the tail appeared ruddy, and the nucleus a greenish yellow. The latter was very brilliant, and surrounded by a coma which seemed to proceed in a double jet of faintly luminous matter from the centre of the nucleus to a short distance in front of it, and was then bent back to the right and left into the tail, the interval between these jets being filled with cometic matter of still fainter luminosity. The tail immediately

behind the nucleus was remarkably bright and condensed towards its axis.

March 5.—Comet bright but still much marred by moonlight; no perceptible change either to naked vision or in telescope.

Approximate Positions.

Graham's Town M.T.

	d	h	m		h	m		h	m
Feb.	24	15	15	R.A.	19	48	N.P.D.	138	35
	27	16	15	„	20	11	„	133	45
March	3	16	0	„	19	22	„	125	50

March 19.—The comet is still visible, and was last seen by myself on the 17th, when it appeared to be still equal to a 4th mag. star, and when viewed in the 9-inch Calver, a very bright object, with a tail of highly condensed matter which bore well a power of 100. The nucleus appeared to be slightly diffused on the preceding border. The tail was 6° in length before Venus-rise on March 13, when I obtained a favourable view of the comet; but after Venus-rise it could not be traced further than 2½° or 3° beyond the head. When viewed in the reflector the tail could be seen as sharply defined on both borders to about 2°, where it suddenly narrowed to about half its width, the northern half only being continued with sharp outline on its exterior, but rugged on the interior.

Approximate Positions.

d	h	m		h	m	s		h	m
March 8	16	0	R.A.	20	45		N.P.D.	118	30
9	16	0	„	20	47	30	„	117	30
12	16	20	„	20	59		„	112	30
14	16	0	„	21	4	30	„	109	40
16	16	30	„	21	11	30	„	106	30

Sextant Observations of Comet a, 1888.
By Captain James Clarke, R.N.R., s.s. *Olbers.*

(Communicated by Captain H. Toynbee.)

1888, February 26, 4 A.M., apparent time at ship in latitude 30° 1' S., longitude 48° 30' W. Greenwich date, February 25, 19^h 18^m 10^s.

Comet bearing from	Antares	S.E. by S. 46	11
„ „	α Centauri	East	46 48
„ „	Altair	S.W. by S. 55	15

Length of tail from nucleus, 4°.

Observations of Comet α , 1888. By John Tebbutt.

(Communicated by A. A. Common.)

Intelligence of the discovery of this comet at the Cape of Good Hope reached my observatory about noon on February 23, but the weather, which up to that time had been fine, suddenly became cloudy. I have observed the comet with the 8-inch equatorial and filar micrometer on every clear morning since that date. The nucleus is small and brilliant, and admits of precise observation. In consequence of the Moon's presence the comet is not a conspicuous object to the unassisted eye, its tail being only two or three degrees in length. By the mail now going out I forward you the following five positions. They depend on well-determined stars, but unfortunately in some instances the comparison intervals were large. The positions for the first two dates are corrected for refraction, but this correction, which cannot in any case exceed a second of arc, has not yet been applied to the differential results for the remaining dates.

1888.	Windsor Mean Time.				Comet's Apparent R.A.			Comet's Apparent N.P.D.			No. of Comps.	Comp. Star.
	d	h	m	s	h	m	s	°	'	"		
Feb.	27	16	35	34	20	2	10.75	...			17	1
	27	16	35	34	20	2	10.93	134	20	28.2	17	2
	28	16	34	30	20	6	53.64	132	52	32.8	4	3
March	2	17	9	9	20	20	13.76	128	21	26.4	3	4
	3	16	42	37	20	24	18.10	126	52	7.3	5	5
	3	16	42	37	20	24	17.92	126	52	6.9	5	6
	4	16	35	54	20	28	18.55	125	21	6.3	5	7

Mean Places of the Comparison Stars for 1888.0, with the Reductions.

Star.	R.A.			N.P.D.	Reductions.	Authority for Mean Place.
	h	m	s			
1	20	1	38.82	134 14 28.6	-2.00 -6.0	Stone, 10799.
2	20	2	18.07	134 13 12.6	-2.01 -6.0	Stone, 10803.
3	20	4	41.78	133 6 30.5	-1.95 -5.7	Stone, 10820.
4	20	27	37.71	128 28 18.5	-1.85 -3.6	Stone, 10965.
5	20	9	6.17	126 47 39.2	-1.69 -4.5	Stone, 10840.
6	20	14	25.88	126 57 42.9	-1.72 -4.2	Cordoba Zone, 22, 55.
7	20	16	33.76	125 29 15.3	-1.67 -3.8	Stone, 10897.

Windsor, N. S. Wales:
1888, March 6.

On the Difference of Longitude between Mr. Tebbutt's Observatory, Windsor, New South Wales, and the Government Observatories at Sydney and Melbourne. By John Tebbutt.

On a single evening both in 1865 and 1878 the difference of longitude between my observatory and the Sydney Observatory was determined by telegraphic signals, the results being respectively $1^m 30^s.04$ and $1^m 28^s.83$. The time at Windsor for both these provisional determinations was derived from observations with a 2-inch transit instrument, and the preference was given to the latter result. As the longitude of Windsor was determined with great precision in 1884, by Dr. Auwers, from a long list of lunar occultations of stars, it was thought advisable in 1885 to redetermine the difference of longitude with all possible accuracy, inasmuch as more improved means existed here for the determination of the local time. It was therefore arranged to exchange telegraphic signals on three evenings in May 1885. As my observatory was not itself telegraphically connected with the Sydney Observatory, a mean-time chronometer had to be carried to the local telegraph office, distant about half a mile, for the transmission and reception of the signals. Signals were sent by hand to Sydney at every tenth second of the chronometer and recorded there on the transit-clock chronograph. It was arranged to receive seconds-signals from the Sydney clock, and to compare them with the chronometer by the method of coincidence of beats, but owing to the length and indefiniteness of the signals the attempt did not succeed. On the last evening signals were sent by hand from Sydney at every tenth second, being recorded there on the chronograph and compared at Windsor with the mean-time chronometer. In the autumn of last year it was suggested by Professor Harkness, of Washington, that the longitude from both Sydney and Melbourne should be determined with all possible care. During the winter several series of signals were accordingly exchanged between Windsor and the two observatories. The signals from Windsor were sent by hand from the local telegraph office at every tenth second by means of a mean-time chronometer, which was itself compared by coincidence of beats with the standard sidereal chronometer of my observatory both immediately before and after the exchange of signals, the latter timekeeper being regulated by the observation of a group of stars both shortly before and after the signals. The signals were recorded on the transit-clock chronograph at Sydney or Melbourne. The signals received at Windsor were sent at every second by the Sydney or Melbourne clock for the space of fifteen or twenty minutes with a break at the end of every minute, and compared with the mean-time chronometer by the method of coincidence of beats. On several occasions I also made trips to Sydney by railway in order to compare a mean-time chronometer with my standard

sidereal chronometer and the Sydney transit-clock. The comparisons of the chronometers were made by watching for the coincidence of beats, and those of the mean-time chronometer and the clock either by this method or by signals with the observing key recorded on the clock chronograph. As the mean-time chronometer was usually absent from my observatory only about twelve, and never more than twenty-four hours, the results from the transportation of the chronometer ought to be fairly good. The personal equation between Mr. Lenehan and myself was obtained from three evenings' observations at the Sydney Observatory. There has been no opportunity for determining that between Mr. White and myself. It appears that some years ago the Lenehan-White was found to be $+0^s.12$, and this, combined with the value Tebbutt-Lenehan $+0^s.06$, gives $+0^s.18$ as a probable approximate value for Tebbutt-White.

With the foregoing brief explanation of the method adopted in the determination of the differences of longitude I now submit the following results of my investigation, and I trust to be able in the course of a short time to publish in a separate form the details of the work.

Difference of Longitude, Sydney-Windsor, from Telegraph Signals.

Date.	Signals.	Coincidences.	Windsor to Sydney.	Sydney to Windsor.
			m s	m s
1885, May 28	35	...	1 29.29	...
28	17	...	1 29.24	...
29	22	...	1 29.33	...
29	35	...	1 29.34	...
29	37	...	1 29.36	...
30	42	...	1 29.32	...
30	29	...	1 29.31	...
30	37	...	...	1 29.34*
1887, June 8	21	...	1 29.37	...
8	...	4	...	1 29.36
July 7	22	...	1 29.39	...
7	...	5	...	1 29.36
7	...	5	...	29.39
7	22	...	1 29.28	...
Mean of all, with equal weights		...	1 29.32	1 29.36
Personal equation, T.-L.		...	+ 0.06	+ 0.03
Difference of longitude		...	1 29.38	1 29.39
			Mean = 1 29.39	

* This difference was obtained by estimating the fractions of the half-seconds of the chronometer corresponding to the Sydney signals.

Difference of Longitude, Sydney-Windsor, from the Transportation of the Chronometer.

Date.	Key Signals.	Coincidences.	Difference of Longitude from Observer's key and chronograph. m s	Coincidence of beats. m s
1887, May 13	...	13	...	1 29'47
20	...	10	...	1 29'48
June 3	...	9	...	1 29'21
July 8	...	10	...	1 29'38
20	21	...	1 29'40	...
20	22	...	1 29'38	...
20	...	6	...	1 29'45
Nov. 24	18	...	1 29'75	...
24	19	...	1 29'70	...
24	...	5	...	1 29'72
Dec. 14	21	...	1 29'27	...
14	14	...	1 29'27	...
14	...	5	...	1 29'28
Mean of all, with equal weights	...	...	1 29'46	1 29'43
Personal equation, T.-L.	...	...	+0'06	+0'03
Difference of longitude	...	...	1 29'52	1 29'46

Mean = 1 29'49

Difference of Longitude, Windsor-Melbourne, from Telegraphic Signals.

Date.	Signals.	Coincidences.	Windsor to Melbourne. m s	Melbourne to Windsor. m s
1887, June 13	22	...	23 25'86	...
13	...	4	...	23 25'96
13	10	...	23 25'88	...
15	22	...	23 26'05	...
15	...	3	...	23 26'08
15	...	4	...	23 26'22
15	22	...	23 26'09	...
23	22	...	23 26'00	...
23	...	5	...	23 26'19
23	22	...	23 26'05	...
Aug. 15	19	...	23 25'87	...
15	...	8	...	23 26'18
15	19	...	23 25'92	...
Mean of all with equal weights	...	...	23 25'97	23 26'13
Correction for assumed personal equation, T.-W.	...	...	-0'18	-0'18
Difference of longitude	...	...	23 25'79	23 25'95

Mean = 23 25'87

It will be seen that the sum of the telegraphic mean differences in the preceding tables is $24^m 55^s.26$, which is less than the result obtained directly between Sydney and Melbourne, and published in the "Report on the Telegraphic Determination of Australian Longitudes," by $0^s.14$.

I may add that I have recently made a trigonometrical connection between my transit instrument and the north terminal of the Government base-line, about three miles nearly due west of my observatory. As the terminal could not be seen from the observatory, the position of an intermediate well-defined object was determined from bases at the observatory and the terminal. The chief officer of the Trigonometrical Survey here gives the following as the position of the terminal:

Longitude west of Sydney Observatory = $1^m 42^s.73$

Geographical latitude = $-33^\circ 35' 58''.07$

The differences of longitude and latitude between my transit instrument and the terminal as deduced trigonometrically are:

Longitude of terminal west = $12^s.96$

Latitude of terminal north = $32''.41$

A comparison of these results gives $1^m 29^s.77$ as the longitude of my transit instrument west of the Sydney transit-circle. This is somewhat larger than the value obtained from the exchange of time signals with Sydney. Again adopting the above latitude of the terminal, I get $-33^\circ 36' 30''.48$ as the latitude of my transit instrument, which differs only $0''.3$ from the value obtained directly from prime vertical observations in 1881. The trigonometrical work was performed with an ordinary steel tape and a common theodolite reading only to minutes of arc. The two triangles formed were ill-conditioned, but I nevertheless think the work was sufficiently accurate to give the difference of longitude to $0^s.01$ and that of latitude to $0''.1$.

Private Observatory, Windsor, N. S. Wales:
1888, February 24.

Erratum in Mr. Bryant's Paper, vol. xlviii. page 96.

The R.A. of Star No. 16 should be $13^h 26^m 47^s$ instead of $13^h 25^m 47^s$.